UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Lung Nodule Malignancy Prediction from Computed Tomography Images using Deep learning

by

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For the Ph.D. degree in Computer Science and Engineering

Lung cancer is the leading cause of cancer-related deaths globally, which makes early detection and diagnosis a high priority. Lately, convolutional neural networks are being used to analyze lung nodules. In this research, deep learning and radiomics features were used for predictive analysis using subsets of participants from the National Lung Cancer Screening Trial. We investigated whether deep learning in combination with radiomics features and clinical knowledge can enhance malignancy prediction. Further two approaches were investigated, whether the prediction of future nodule malignancy could be further enhanced by an ensemble of classifiers using different feature sets and learning approaches. The best-known AUC of 0.94 and accuracy of 90% were obtained, which are improvements over the previous best AUC of 0.87 and accuracy of 76.79%. Stability and explainability of deep features were also analyzed.

Examining Committee
Dr. Yasin Yilmaz, Ph.D., Chairperson
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Tuesday, March 3rd, 2020
2:30PM
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Publications

1) R. Paul, M. M. Schabath, R. Gillies, L. Hall, D. Goldgof, "Mitigating Adversarial Attacks on Medical Image Understanding Systems", ISBI 2020 (ACCEPTED).
2) R. Paul, D. Cherezov, M. Schabath, R. GilliesL. Hall, D. Goldgof, "Towards deep radiomics: nodule malignancy prediction using CNNs on feature images", SPIE Medical Imaging 2019, San Diego, CA, 2/2019.
3) R. Paul, M. Schabath, Y. Balagurunathan, Y. Liu, Q. Li, R.Gillies, L. Hall, D.Goldgof, "Explaining Deep Features using Defined Semantic Features and Traditional Quantative Features", Tomography, 5(1), 192 (2019), doi: 10.18383j.tom.2018.00034
4) R. Paul, L. Hall, D. Goldgof, M. Schabath, R. Gillies, "Predicting Nodule Malignancy using a CNN Ensemble Approach", The International Joint Conference on Neural Networks (IJCNN), Rio, Brazil,7/2018.
5) R. Paul, Y. Liu, Q. Li, L. Hall, D. Goldgof, Y. Balagurunathan, M. Schabath, R. Gillies, "Representation of Deep Features using Radiologist defined Semantics", The International Joint Conference on Neural Networks (IJCNN), Rio, Brazil, 7/2018
6) R. Paul, M. Shafiq-ul-Hassan, E. Moros, R. Gillies, L. Hall, D. Goldgof, "Stability of deep features across CT scanners and field of view using a physical phantom", SPIE Medical Imaging 2018, Houston, TX, 2/2018.
7) R. Paul, S. Hawkins, M. Schabath, R. Gillies, L. Hall, D. Goldgof, "Predicting Malignant Nodules by Fusing Deep Features with Classical Radiomics Features", Journal of Medical Imaging, 5(1), 011021 (2018), doi: 10.1117/1.JMI.5.1.011021
8) R. Paul, S. Hawkins, Y. Balagurunathan, M. Schabath, R. Gillies, L. Hall, D. Goldgof, "Deep Feature Transfer Learning in Combination with Traditional Features Predicts Survival among Patients with Lung Adenocarcinoma", Tomography Journal, Special QIN Issue, 2016, v.2(4), pp. 388-395, 2016, doi: 10.18383/j.tom.2016.00211
9) R. Paul, S, Hawkins, L. Hall, D. Goldgof, R. Gillies, "Combining Deep Neural Network and Traditional Image Features to Improve Survival Prediction Accuracy for Lung Cancer Patients from Diagnostic CT", IEEE International Conference on Systems, Man and Cybernetics (SMC 2016), Budapest, Hungary,10/2016.

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